STUDY OF OUTCOME FOLLOWING RIGID FIXATION OF MANDIBULAR FRACTURES WITHOUT PER OPERATIVE OR POST OPERATIVE MAXILLO- MANDIBULAR FIXATION AND IMMEDIATE MOBILISATION

– A PROSPECTIVE STUDY

Dissertation submitted to

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

In partial fulfillment of the regulations

for the award of the degree of
MCh BRANCH – III
PLASTIC AND RECONSTRUCTIVE SURGERY

INSTITUTE FOR RESEARCH AND REHABILITATION OF HAND

AND

DEPARTMENT OF PLASTIC SURGERY

CHENNAI - 600 001

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CERTIFICATE

This is to certify that this dissertation titled "**STUDY OF OUTCOME FOLLOWING RIGID FIXATION OF MANDIBULAR FRACTURES WITHOUT PER OPERATIVE OR POST OPERATIVE MAXILLO- MANDIBULAR FIXATION AND IMMEDIATE MOBILISATION – A PROSPECTIVE STUDY**" is a bonafide research work done by Dr.R.Subashini, M.Ch., Postgraduate student of Plastic Surgery, Department of Plastic Surgery and IRRH, Stanley Medical College, Chennai – 600 001. This dissertation was done under my guidance and direct supervision during the period of October 2010 to September 2012. This dissertation is submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai in partial fulfillment of the award of M.Ch. Degree in Plastic Surgery.

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DECLARATION

I solemnly declare that this dissertation titled "**STUDY OF OUTCOME FOLLOWING RIGID FIXATION OF MANDIBULAR FRACTURES WITHOUT PER OPERATIVE OR POST OPERATIVE MAXILLO- MANDIBULAR FIXATION AND IMMEDIATE MOBILISATION – A PROSPECTIVE STUDY"** is a bonafide research work done by me in IRRH and Department of Plastic Surgery, Stanley Medical College and Hospital, Chennai-1, under the guidance and supervision of Prof.J.Mohan,M.S,M.Ch, Professor and Head of the Department, IRRH and DPS, Stanley Medical College and Hospital, Chennai-1. This dissertation is submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai in partial fulfillment of the award of M.Ch. Degree in Plastic Surgery.

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INTRODUCTION

Of the facial bones, mandible being prominent and mobile gets fractured commonly. It has to heal properly for restoring chewing abilities and aesthetic appearance. The fracture healing is more painful and maintaining the reduction achieved is difficult due to the action of various muscles attached to mandible.

Traditionally, mandible fracture reduction is done with maxillo mandibulary fixation (MMF) to maintain reduction. In patients treated with open reduction and internal fixation with interosseous wiring MMF is applied for 2-3 weeks. Even for fractures fixed with plates and screws, intra operatively MMF is applied prior to plating to maintain proper occlusion. With MMF patient cannot open his mouth and has difficulty in speaking and eating and also he has to take only fluid diet. The presence of stainless steel wire and arch bars between jaw and lips is cumbersome for the patient causing mechanical irritation and difficulty in maintaining oral hygiene. Also, there is the chance for the surgeon to get pricked by stainless steel wire while applying the MMF. Application of arch bars and MMF consumes time.

There are few reports about fixing mandible fracture with intraoperative manual maintenance of occlusion without applying arch bars and MMF. Hence this study is done to evaluate outcome of the mandible fracture when rigid fixation is done with manual maintenance of occlusion.

AIM

To study the demographics of mandible fractures.

To study the causes and nature of mandible fractures.

To evaluate the outcome of fracture mandible following rigid fixation without the need of arch bar or MMF application in the intra operative or post operative period.

MATERIALS & METHODS

This is a prospective study done from October 2010 to September 2012.

Patients referred from trauma ward with mandible fracture were evaluated. Patients with alveolar fractures of mandible, other facial bone injuries, other life threatening injuries were excluded from study.

History was taken regarding mode of injury and symptoms. Thorough physical examination was done to assess the general condition of patient, associated injuries, site and number of mandible fractures and the occlusion status.

To evaluate mandible fractures X ray skull, orthopontomogram, CT scan facial bones with 3D reconstruction were done. Basic investigations were done for anaesthesia fitness.

Forty six patients who underwent rigid fixation without arch bar application or MMF were included in the study. All patients received antibiotics pre operatively. Surgery was performed under general anaesthesia. Incisions used were intra oral or extra oral.

Maintenance of occlusion manually-

Intraoperatively, the occlusion is established by holding the fracture reduced by the assisting surgeon while the surgeon fixes the fracture with mini plates and screws. The anterior surface and inferior border of mandible are kept in

alignment thus ensuring the reduction of fracture. Mandible has to be exposed very well to achieve good occlusion and reduction.

In case of difficulty, sliding holes with burr are made on either side of fracture line and a bone holding forceps is used to reduce the fracture and then occlusion is maintained. Miniplates of thickness 2 mm and screws of size 6x2 mm were used.

Post operatively patient was allowed to have clear fluids and gradually introduced to soft diet over 2 days. Post operative orthopantomogram was taken to confirm reduction. Patients were followed up for a minimum period of three months. Outcome of surgery was assessed by integrity of union, occlusion status, radiological reduction status, post operative complications.

REVIEW OF LITERATURE

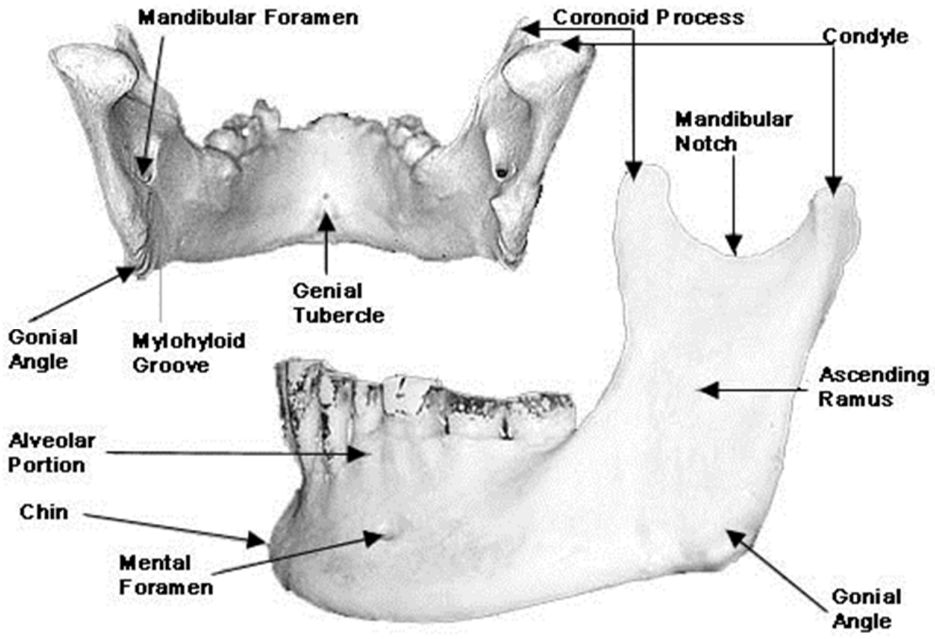
ANATOMY-

Mandible is a U shaped bone. It develops from the first pharyngeal arch. It is composed of two hemimandible which fuse to form a single bone by age of two years.

Components of mandible-

Each hemi mandible consist of parasymphysis, body, angle, ramus, condyle and coronoid process united in the midline by symphysis.

FIGURE-1- PARTS OF MANDIBLE



Parasymphysis-

From midline to till canine region.

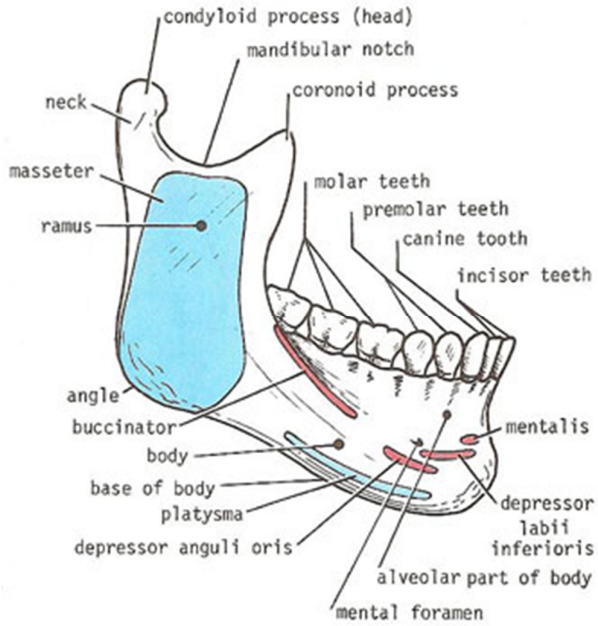
Body of the mandible-

It has an inner and outer surface and upper and lower borders.

Outer surface of body-

- Symphysis menti- a faint ridge where the two body meet.
- Mental protuberance- median triangular projecting area in the lower part of midline.
- Mental foramen- in the interval between the premolar teeth. Transmits mental nerve and vessels.
- Oblique line- continuation of sharp anterior border of ramus. Buccinator, depressor labii inferioris and depressor anguli oris arise from oblique line.

FIGURE-2- OUTER SURFACE OF MANDIBLE

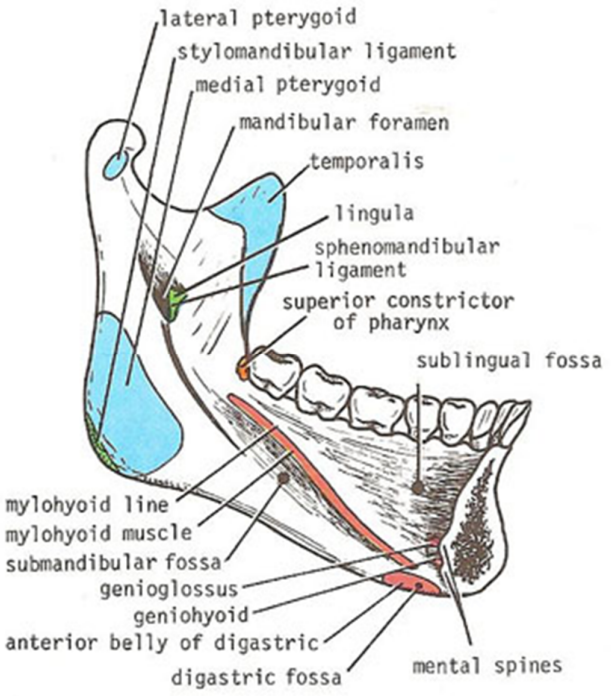


- Incisive fossa- depression that lies just below the incisor teeth. Gives origin to mentalis and mental slips of the orbicularis oris.

Inner surface of body-

- Mylohyoid line- prominent ridge running obliquely downwards and forwards from below the third molar tooth to the median area below genial tubercles. Gives origin to the mylohyoid muscle, Superior constrictor muscle and Pterygomandibular raphe.

FIGURE 3- INNER SURFACE OF MANDIBLE



- Submandibular fossa- just below mylohyoid line where submandibular gland lies.

- Sublingual fossa- above mylohyoid line where sublingual gland lies.
- Superior and inferior genial tubercles- four small elevations in posterior aspect of symphysis menti. Superior genial tubercle gives origin to genioglossus and inferior genial tubercle to geniohyoid.
- Mylohyoid groove- below posterior end of mylohyoid line extending to ramus

Upper border- bears sockets of teeth.

Lower border- near midline an oval depression called digastrics fossa. Anterior belly of digastric muscle arises from digastric fossa. Platysma is inserted.

Ramus of the mandible-

Quadrilateral in shape and has lateral and medial surfaces, upper, lower, anterior and posterior borders.

Lateral surface-

- Flat, bearing a number of oblique ridges. Masseter gets inserted.

Medial surface-

- Mandibular foramen- lies above the centre of ramus leading to mandibular canal which descends into body of mandible and opens

at mental foramen. Inferior alveolar nerve and vessels enters the mandibular canal through mandibular foramen.

- Lingula- anterior margin of mandibular foramen. Sphenomandibular ligament is attached.
- Mylohyoid groove- just below mandibular foramen. Just below the groove medial pterygoid muscle is inserted. Mylohyoid nerve and vessels lie in this groove.

Upper border-

Thin and curved downwards forming mandibular notch.

Lower border-

Continuation of lower border of body.

Anterior border is thin while posterior border is thick.

Coronoid process- flattened triangular projection from anterosuperior part of ramus. Temporalis is inserted.

Condyle- upward projection from posterosuperior part of ramus. The head is covered with fibrocartilage and articulates with temporal bone forming temporomandibular joint. The constriction below head is neck. Its anterior surface presents a depression called pterygoid fossa where lateral pterygoid muscle is inserted.

BLOOD SUPPLY-

Mandible is supplied by inferior alveolar artery. The artery arises from maxillary artery and descends between spheno mandibular ligament and ramus of the mandible. The inferior alveolar artery and nerve enters the body through mandibular foramen and exit through mental foramen. The nerve lies anterior to artery. Mandible also receives supply from its muscle attachments.

NERVE SUPPLY-

Mandible is supplied by inferior alveolar nerve.

MUSCLE ATTACHMENTS AND DISPLACEMENT OF FRACTURES

The periosteum of mandible is stout and unyielding and gross displacements cannot occur if it remains attached to bone.

Fractures at the angle of mandible are influenced by medial pterygoid masseter sling of which medial pterygoid is stronger. In the vertically and horizontally favourable fractures, the reduced fragments are easier to stabilise. If the vertical direction of fracture line favors unopposed action of medial pterygoid muscle the posterior fragment will be pulled lingually. If the horizontal direction of fracture line favors the unopposed action of medial pterygoid and masseter the posterior fragment will be displaced upwards. The vertically and horizontally unfavourable fractures can be undisplaced if the periosteum is undisturbed.

FIGURE 4- UNFAVOURABLE AND FAVOURABLE ANGLE FRACTURE

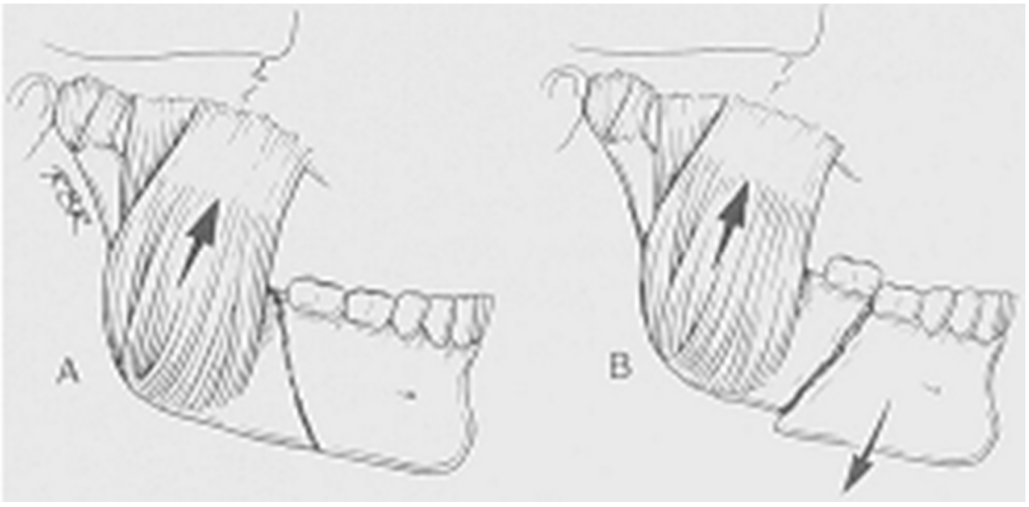
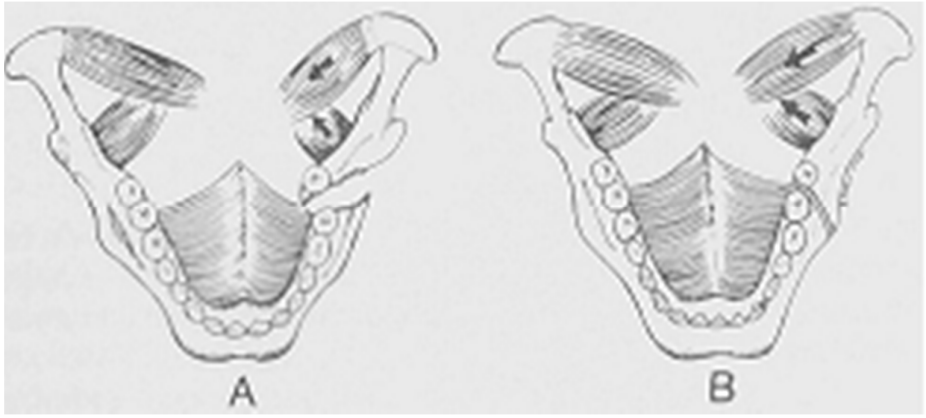


FIGURE 5- UNFAVOURABLE AND FAVOURABLE ANGLE FRACTURE



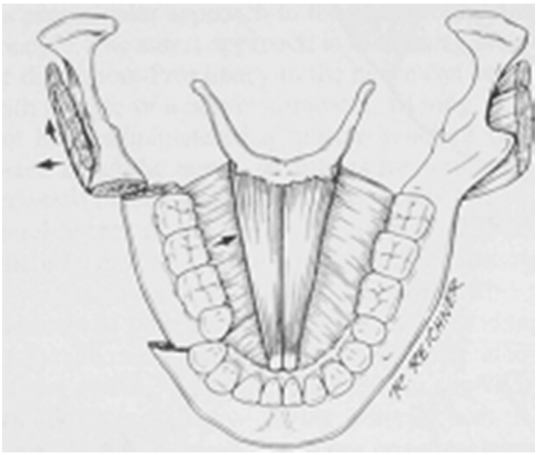
Fracture at the symphysis is influenced by mylohyoid and geniohyoid. When fracture line passes between genial tubercles minimum displacement occurs. In fracture lateral to the midline, the fragment with genial tubercles is displaced lingually by the pull of geniohyoid and mylohyoid muscles.

FIGURE 6- PARASYMPHYSEAL FRACTURES – UNILATERAL AND BILATERAL

In bilateral parasymphyseal fractures , the fractured segment is displaced posteriorly by the influence of genioglossus and geniohyoid.

In segmental fracture of body mylohyoid pulls the fragment medially.

FIGURE 7- SEGMENTAL FRACTURE OF MANDIBLE



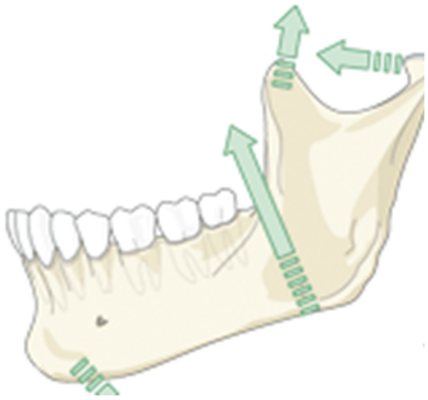
In fracture of condyle of neck the most frequent direction of displacement is medially and forward due to the action of lateral pterygoid muscle.

Coronoid process fracture is rare and said to be due to reflex contraction of temporalis which then displaces the fragment upwards.

BIOMECHANICS OF MANDIBLE

Forces applied to the mandible cause varying zones of tension and compression, depending on where the bite force is located.

Muscle forces



The mandible is a hoop of bone that deforms with movement based on the origin and insertion of the muscles of mastication.

Tension and compression zones

The superior border of the mandible is the tension zone and the inferior border is the compression zone.

Hunting bow concept

The mandible is similar to a hunting bow in shape, strongest in the midline (symphysis) and weakest at both ends (condyles). The most common area of fracture in the mandible is therefore the condylar region.

A blow to the anterior mandibular body is the most common reason for condylar fracture. The force is transmitted from the body of the mandible to the condyle. The condyle is trapped in the glenoid fossa. Commonly, a blow to the ipsilateral mandible causes a contralateral fracture in the condylar region.

If the impact is in the midline of the mandible, fractures of the bilateral condylar region are very common. With a condylar fracture, there is very often shortening of the ramus on the affected side. This will result in an ipsilateral premature contact of the teeth. In case of bilateral fractures, the patient may present an anterior open bite. The condylar fragment may be displaced (most often laterally) based on the angulation of the fracture and predominant muscle pull.

CAUSES OF MANDIBLE FRACTURES

- Road traffic accidents
- Interpersonal violence including gun shot wounds
- Falls
- Sporting injuries
- Industrial trauma

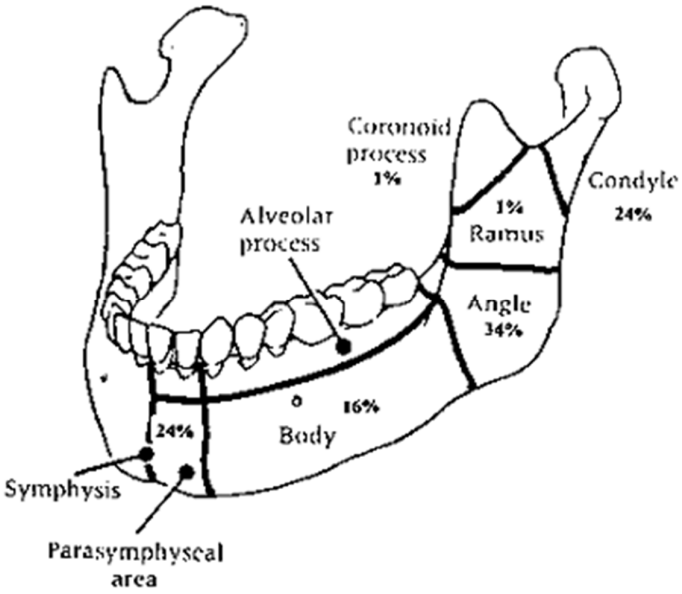
CLASSIFICATION OF MANDIBLE FRACTURES

Six descriptors are commonly used to describe and categorize them:

1. Site
2. Complete versus incomplete
3. Fracture morphology
4. Open/compound versus closed/noncompound
5. Displaced versus nondisplaced
6. Mobile versus nonmobile

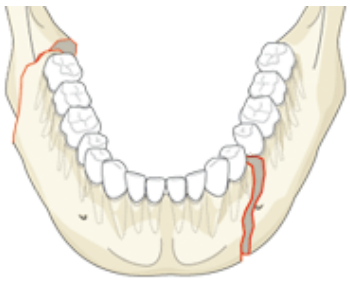
1.SITE -

FRACTURE DISTRIBUTION BASED ON SITE



Multiple fractures

Multiple fractures are those involving more than one anatomical location of the mandible.



2. COMPLETE/ INCOMPLETE-

Complete fractures- Fractures of the mandible in adults are usually complete

so that they interrupt entirely the continuity of the mandibular arch. Such fractures are usually mobile and have various degree of displacement.

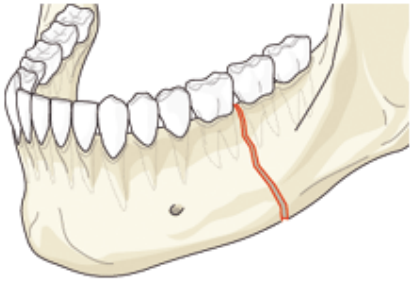
Incomplete fractures- Incomplete fractures do not extend through both the buccal and the lingual cortices as well as the alveolar and basal borders. In such cases, the fracture will be non displaced and non mobile. It may not require surgical treatment.

3. FRACTURE MORPHOLOGY-

The fracture morphology refers to the type of fragmentation (number of fragments and fracture lines) and the displacement. Fracture fall into one of two categories:

- Simple
- Complex

Simple fracture



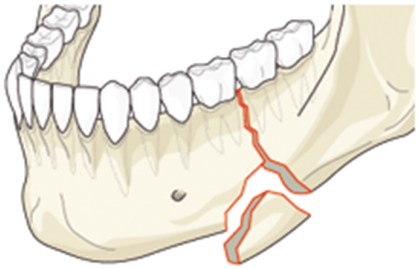
Simple fractures are linear resulting in two fragments.

Complex

Complex fractures involve at least two fracture lines and three or more fragments. Complex fractures include:

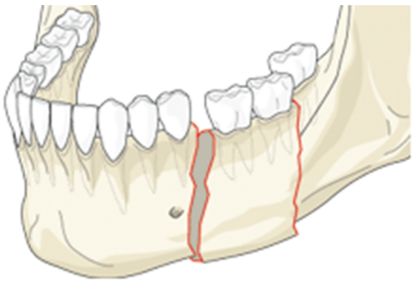
- Basal triangle (wedge) fractures
- Segmental fractures
- Comminuted fractures
- Defect fractures

Basal triangle (wedge) fracture



A basal wedge fracture involves a triangle of bone at the inferior border.

Segmental fractures



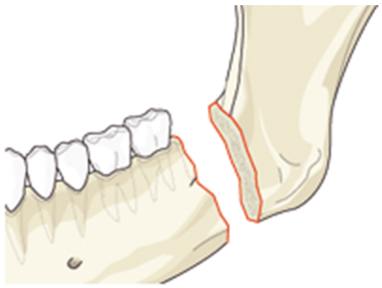
Segmental fractures present two fracture lines, both being complete, within the same anatomic location.

Comminuted fractures

Comminuted fractures involve multiple fracture lines in the same anatomic location resulting in multiple fragments of bone. The bone is often shattered in the area of fracture, with fracture lines running in three dimensions.

Many clinicians consider comminuted fractures as synonymous with multifragmentary fractures.

Defect fractures



Defect fractures are characterized by a loss of bony structure at the fracture site.

4.OPEN / CLOSED-

Intraoral and facial soft tissues adjacent to a fracture can be involved in the injury.

When the fracture site communicates either intraorally through the mucosa or periodontal ligament, or extraorally through a laceration or avulsive injury of the overlying skin, the fracture is considered as open. Therefore all fractures involving the tooth-bearing areas of the jaws are considered as open fractures.

The terms open fractures and compound fractures are synonymous.

The soft tissues (intra and extraoral) adjacent to a closed fracture are intact.

5. DISPLACED/ NON DISPLACED-

Fractures can be considered displaced or nondisplaced depending on the relationship of the fracture ends. A fracture is displaced if the fragments are not perfectly anatomically aligned. Displacement is grossly graded as minimal, moderate and severe. Nevertheless, there is no universally accepted definition for these terms.

The importance of “displacement” is that the more displaced the fracture, the more likely it is to be mobile and contaminated when open.

The terms dislocated, subluxated, and luxated are used to describe the abnormal relationship of the articular surfaces of the condyle and glenoid fossa to one another.

6. MOBILE / NON MOBILE-

Mobile fractures are more painful to the patient because any movement of the mandible such as in speaking, eating or swallowing creates discomfort.

CLINICAL EXAMINATION

Patient general condition is assessed and resuscitated. Life threatening conditions are addressed.

Extra oral examination-

- Swelling and Ecchymosis
- Deformity in bony contour
- Bone tenderness and crepitus
- Reduced or absent sensation on one or both sides of lower lip

Intra oral examination-

- Ecchymosis in buccal and lingual sulci
- Lacerations in the mucosa
- Occlusal plane of teeth- malocclusion, step deformity
- Teeth- subluxation, missing teeth, fillings of teeth, missing crowns, dentures
- Unnatural mobility at fracture site

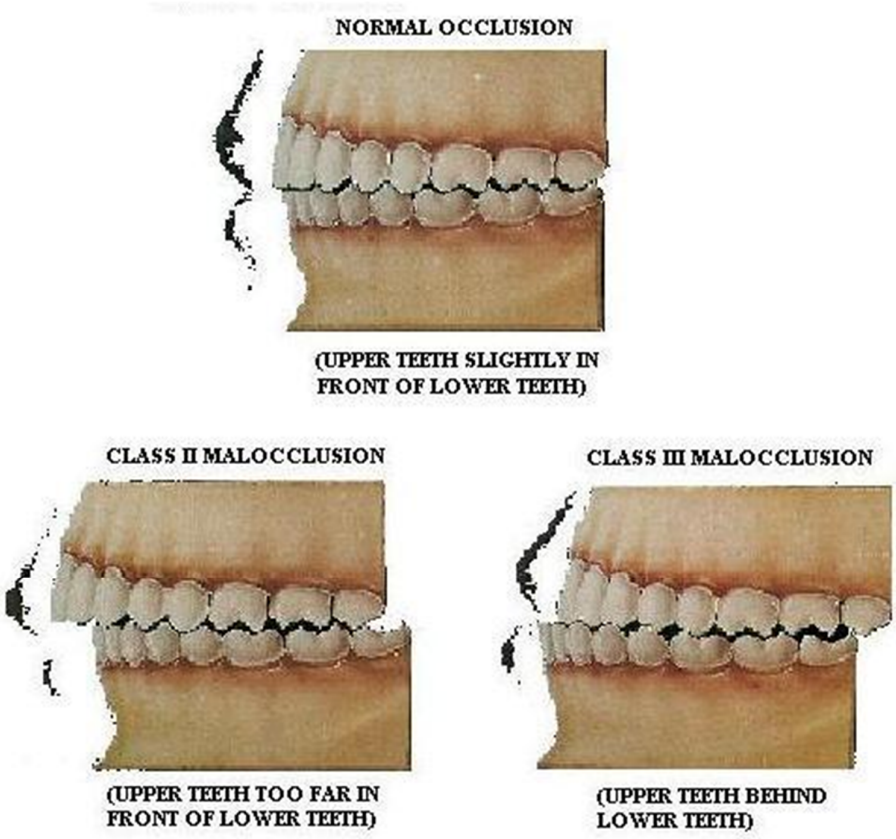
OCCLUSION OF TEETH- ANGLE CLASSIFICATION

In 1890, Edward H Angle defined and classified occlusion.

Class I-normal occlusion- the mesiobuccal cusp of maxillary first molar aligns with buccal groove of first mandibular molar.

Class II- overjet – the mesiobuccal cusp of maxillary first molar is placed anterior, in between the first mandibular molar and second mandibular premolar.

Class III – mesioocclusion- the mesiobuccal cusp of maxillary first molar is placed posterior.



INVESTIGATIONS

Tests to evaluate other injuries and for anaesthetic purpose are done in addition to tests for evaluation of fracture mandible.

- Left and right oblique lateral with the tube angled at 30 degree towards lower jaw – for fractures of body proximal to canine, angle, ramus and condyle
- Postero anterior x ray – fracture of body and angle with displacement.
- Townes projection
- Reverse townes projection
- Rotated postero anterior
- Intra oral
- Panoramic tomography
- Ct scan with 3D reconstruction

ACCESS TO THE MANDIBLE

Good exposure of the fracture site is mandatory for good surgical outcome. In face importance should be given for aesthetics of future scar and care taken to avoid injury to nerves and muscles of facial expression.

TRANSORAL ACCESS-

Incision to be made in buccal mucosa and not over gingiva. This incision gives exposure of symphyseal, parasymphyseal and body fractures. When extended angle, ramus and condyle can also be accessed safely. Closure done in two or more layers. Mentalis should be repaired to avoid postoperative deformity.

Advantage- occlusion status can be assessed continuously.

Complication- mental nerve damage and lip malposition.

2. TRANSBUCCAL ACCESS (TROCAR TECHNIQUE)-

It is a combined intraoral and extraoral access. Trocar and specific instruments are used to place the plate. Then, accessory incisions are made over plate to fix it.

3.TRANSCUTANEOUS ACCESS-

- Submental approach-

  This incision allows exposure of symphyseal, parasymphyseal and anterior body regions.

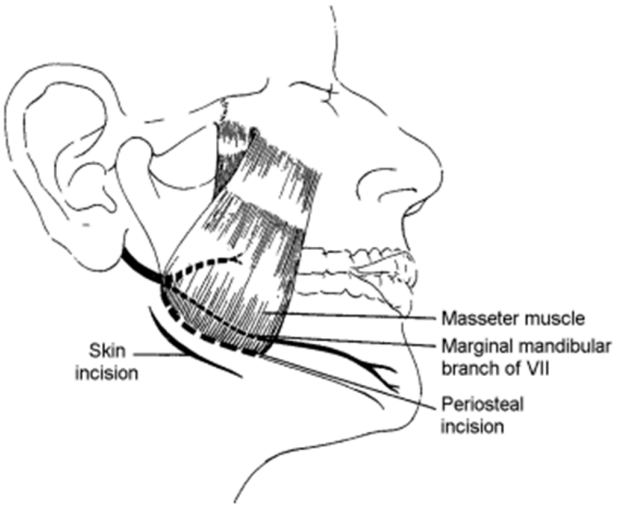
Advantage- Mentalis muscle not divided.

Mental nerve is well protected.

Disadvantage- external scar.

- <u>Risdon approach-</u>

  It is a 2 to 4 cm curved incision placed 2 cm below angle, thus avoiding injury to marginal mandibular nerve. It gives exposure to angle, ramus, midbody.



- Postmandibular approach-

  This incision is made 1-2 cm posterior to border of mandible. It gives exposure to angle, ramus and posterior body regions. Injury to Greater auricular nerve should be avoided.

- Preauricular approach-

  Incision made in preauricular region to expose condyle and tempero mandibular joint. Facial nerve should not be injured.

CHOICE OF FRACTURE TREATMENT

SPLINTS-

Splints used in mandibular fractures are occlusal splint, lingual splint, gunning splint, arch bars and interdental ligatures. They stabilise loose teeth and alveolar fractures.

MAXILLO MANDIBULAR FIXATION-

Maxillaro mandibular fixation refers to wiring together of maxillary and mandibular teeth. Three to four weeks of immobilisation is needed. Weight loss due to MMF has been reported.

OPEN REDUCTION AND MAXILLO MANDIBULAR FIXATION-

This method is employed when closed reduction cannot give good reduction. After open reduction, immobilisation is maintained for six weeks.

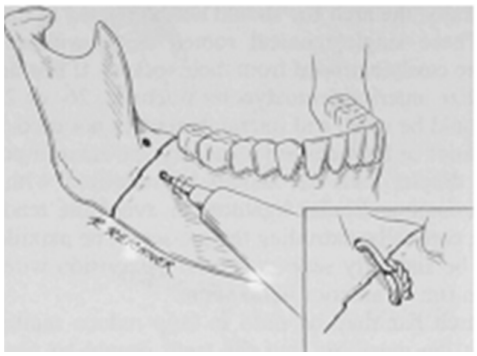
EXTERNAL FIXATION-

This method is employed in severe infection and inadequate soft tissue to cover the internal hardware. Pin sites have to be cleaned and ointment applied daily. Scarring of the pin sites is a great disadvantage.

INTERNAL FIXATION-

- Wire osteosynthesis

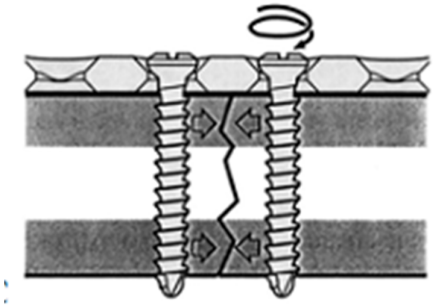
  A simple wire ligature is passed through a pair of holes placedon either side of fracture. Alternatively a pair of holes can be placed on either side of fracture and then the wire is criss crossed. This method allows micromotion.



- Metal plate and screw fixation-

  Non rigid plate and screw fixation-

  In this technique unicortical miniplate fixation is done. The minplate is placed in superior portion of mandible to resist distraction. A second plate to resist torsion is placed inferiorly.

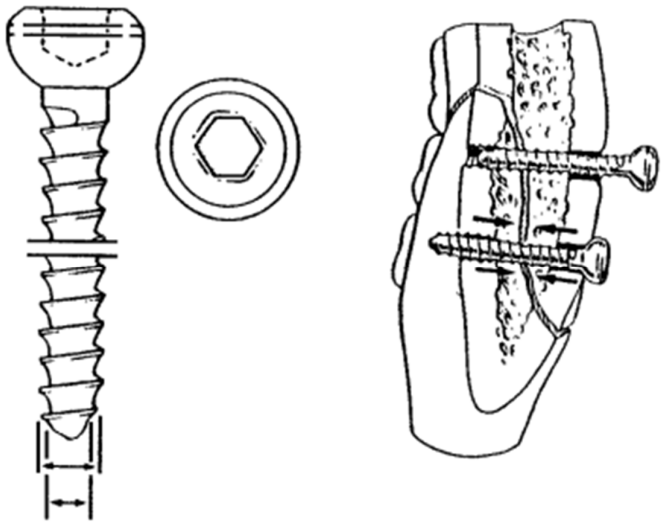


Rigid plate and screw fixation-

In this technique adequate number of screws is placed on either side of fracture. There is no micromotion. Compression plates are also used.

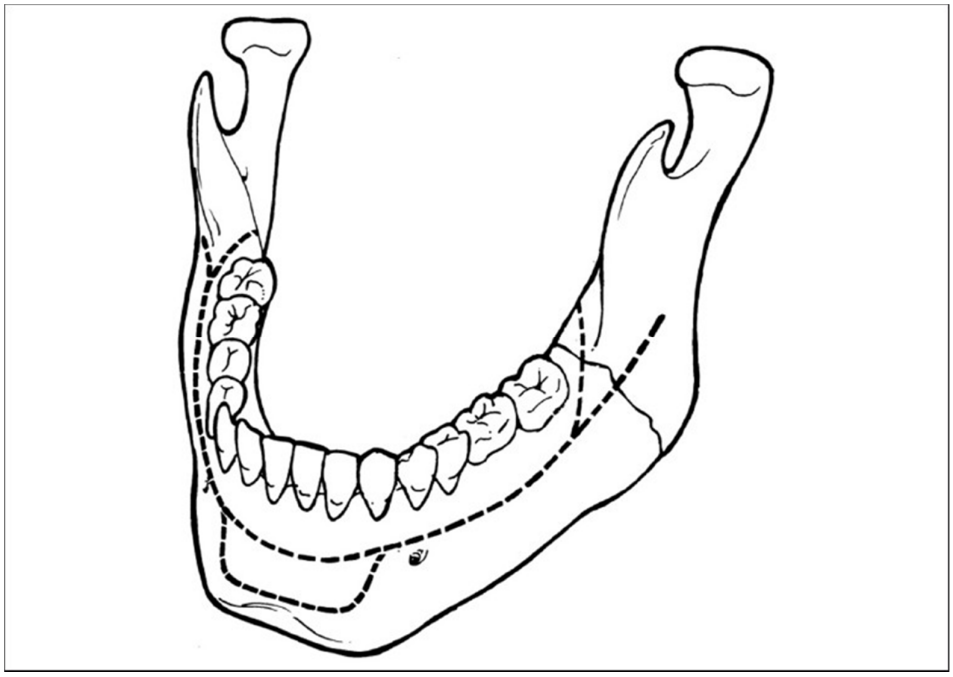
Compression (lag) screw fixation-

The principle is to place one or more screws through fragments so that the threads of screw take hold only in the far or deep cortical bone. This is very effective in oblique fractures. The screw has to placed perpendicular to fracture. Since a single lag screw cannot resist rotation, atleast two screws are required to resist rotation.



CHAMPY'S IDEAL LINE OF OSTEOSYNTHESIS

Champy et al delineated ideal line of osteosynthesis along which plate has to be placed. It provides optimal fixation and stability. He advocated use of single miniplate.



Fractures of the angle can be managed with a single plate in the upper border. In the canine region two plates are required, one juxta alveolar and one at lower border.

MANAGEMENT OF TEETH IN THE LINE OF FRACTURE

A common problem in managing mandibular fractures involves dealing with teeth in the line of fracture. Commonly, there are impacted wisdom teeth associated with mandibular angle fractures. However, any fracture involving the dentate areas of the jaw has the potential to involve erupted teeth in the fracture line.

The surgeon can either remove the offending tooth or leave it in place if it is thought not to compromise the result of fracture treatment.

Indications for removal of teeth in the line of fracture

1. Tooth luxated from its socket and/or interfering with reduction of the fracture.
2. Tooth that is fractured (as illustrated).
3. Tooth with advanced dental caries carrying a significant risk of abscess during treatment.
4. Tooth with advanced periodontal disease with mobility which would not contribute to establishment of stable occlusion.
5. Tooth with existing pathology such as cyst formation or pericoronitis.

Indications to leave teeth in the line of fracture

1. Tooth that does not interfere with reduction and fixation of fracture.

2. If tooth removal requires removal of excessive amount of bone so as to compromise the fracture site an possible plate/screw fixation.
3. Tooth that is in good condition and assists in establishing occlusion and reducing the fracture.

POST-OPERATIVE CARE

This is divided into three phases

1. Immediate postoperative phase

- Take care of airway, if required cut MMF and take a tongue stitch or sometimes tracheostomy
- Prevent vomiting, if it comes nurse in left lateral position

2. Intermediate phase

- Observe maintenance of reduction and immobilization
- Most patients find it comfortable in sitting position and nurse so
- Sedation is contra-indicated as it might compromise respiration
- Prophylactic antibiotics for compound fractures
- Effective oral hygiene maintenance
- In conscious cooperative patients, liquid or semi-solid diet
- In unconscious or uncooperative patients, enteral feeing through nasogastric tube or parenteral therapy

3. Late phase

- Little adjustment of occlusion if required
- Mobilization of temporomandibular joint
- If there is sensory loss, microneural repair of inferior dental and lingual nerve can be done.

COMPLICATIONS

- MALOCCLUSION-

  Malocclusion is the most common complication. Casuses of malocclusion are severe injury, malalignment of fracture fragments and patient non compliance.

  Minor malocclusion can be corrected with occlusal splints. Severe malocclusion has to be corrected by reapplying the plates with MMF.

- DELAYED OR NON UNION-

  Delayed are more commonly due to inadequate stabilisation. If a fibrous union is present the fracture will heal with bony consolidation.

  Non union occurs due to infection, inadequate opposition of bone. It has to be treated by re exploration, and fixation with bone grafts.

- MALUNION-

  Malunion has to be treated with osteotomy at fracture site and re fixation. If there is a bone gap bone grafting has to be done.

- INFECTION-

  Infection is seen in compound fractures, fracture fixation with less stability and poor oral hygiene. It is treated with culture specific antibiotic, drainage and stable, rigid fixation of mandible.

- EXPOSED OR LOOSE HARDWARE-

  Hardware get exposed when there is infection, wound contracture and when a dental prosthesis is worn over hardware. Minor exposure is managed conservatively till fracture union whereas major exposure requires hardware removal and more stable fixation.

- SENSORIMOTOR DISTURBANCES-

  Sensory disturbances of inferior alveolar nerve and mental nerve occur. Motor disturbances due to injury to marginal mandibular nerve and facial nerve have been reported. The prognosis depends on the type of damage to nerve.

- EXACERBATION OF DENTAL DISEASE-

  Exacerbation of existing dental disease like caries can happen when oral hygiene is not maintained.

- TEMPOROMANDIBULAR JOINT PAIN-

  TM joint pain and dysfunction can occur in MMF. Longer period of immobilisation causes severe changes. Simple jaw exercises and mechanical exercisers can improve the condition.

  Fibrodysplasia ossificans can occur when hematoma in the muscle organises and ossifies. The ectopic bone has to be excised but there is a chance of recurrence.

- SCARS- Unsightly scarring may be seen in compound fractures. Initially scar massaging done followed by scar revision later.

HISTORY

- **Ancient Egypt: The Edwin Smith Treatise**

Written approximately 3000 B.C. in hieroglyphics, but "carpetbagged" by American Edwin Smith in approximately 1862, who bought it off an Egyptian peasant for mere trinkets. "If thou examinist a man having a fracture in his mandible, thou shouldst place thy hand upon it... and find that fracture crepitating under thy fingers, thou shouldst say concerning him: One having a fracture in his mandible, over which a wound has been inflicted, thou will a fever gain from it. An ailment not to be treated." Cause of death was assumed to be sepsis.

- **Ancient Greece- Hippocrates**

Written in 460 B.C. The first description of closed reduction with inter-dental wiring! . "Displaced but incomplete fractures of the mandible where continuity of the bone is preserved should be reduced by pressing the lingual surface with the fingers while counter pressure is applied from the outside. Following the reduction, teeth adjacent to the fracture are fastened to one another using gold wire."

- **"Modern" Europe**

The first European medical school, in Salerno, Italy, was established in 1180 AD. "(for mandibular fractures)...take olibaisum, mastic, colophene, glue

and dragon blood; all this must be mixed with liquefied resin until it becomes ointment, which is placed over (the fracture)..."

- **America - Thomas Gunning**

A dentist during the civil war, during which time the therapy of mandibular fractures was greatly advanced. Designed the "Gunning splint" in 1984 for William Seward, the Secretary of State to Abraham Lincoln, who suffered bilateral body fractures after falling out of a carriage. The splint was a single piece of vulcanite with a space for eating. Screws were used to stabilize the splint to the hard palate and the mandible. Gunning declared Mr. Seward cured after several months of therapy. His assessment and methods were highly controversial, however, and most considered his treatment unsatisfactory.

- **America - "Mr. Thomas"**

Apparently a ship's carpenter who fancied himself a scientist. Pioneered open reduction with internal fixation in 1869 after a friend was struck by a piece of timber aboard ship. He writes: "There was great mobility of the fractured part. My assistant kept him steady with a piece of wood directed across his face whilst I drilled a hole through the jaw. A strong silver wire was passed through ... and drawn tight, making the fracture firm. The site was tightened every four days. In four weeks it was sufficiently secure to allow the wire to be removed and the jaw used."

- **World War II-**

Milton Adams introduced internal skeletal fixation for maxillary injuries and suppression technique. John Converse treating british soldiers' adapted external pin fixation without MMF.

- **Robert Danis-**

In 1949, published theorie et pratique de osteosyntheses and made great contributions to the field of internal fixation. He advocated that immobilisation causes degenerative changes in the effected joints, bones, ligaments and muscles (fracture disease) hence after fracture fixation it should not be immobilised.

- **Pauwels-**

He did experiments on tension compression zone concept of bone biomechanics. He advocated that fixation plates to be placed where there is greatest force of tension from muscle forces.

- **Association for osteosynthesis [AO], Switzerland-**

AO group established four principles of fracture treatment. They are as follows

1. Anatomic reduction
2. Rigid internal fixation
3. Atraumatic technique on bone and soft tissues and

4. Early pain free active mobilisation in the first ten post operative days.

- **Luhr, 1968-**

He used vitallium compression plate with self tapping screws for internal fixation of mandible.

- **Mittelmeir, 1968-**

Mittelmeir reported usage of compression plates in mandible fractures.

- **Brons, 1970-**

He was the first to introduce lag screw technique in maxillofacial surgery.

- **Michelet, 1973-**

He placed small, non compressible plates transorally and fixed it with unicortical screws.

- **Champy, 1976-**

Champy et al did lots of experiments with miniplates and described the transition zone between areas of tension and compression. They argued that compression plates were unnecessary because of the natural line of compression along lower border of mandible. He delineated the line of ideal osteosynthesis.

JOURNAL ARTICLES

Schenk and Willinegger et al (1967) reported that compression osteosynthesis results in primary bone healing without callus formation. Primary bone healing results in more rapid stabilisation of fracture site and much earlier restoration of mechanical strength of bone.

In 1973, Juniper and Awty showed that in favourable circumstances stable union can be achieved after three weeks at whuch time MMF can be released.

In 1974, becker pointed out that any treatment method which does not rely on MMF must ensure the restoration and maintenance of correct occlusion.

Reitzik and Schoorl (1983) compared rigid non compression osteosynthesis and semi rigid wired osteosynthesis on either side of same mandible and found that non compression rigid fixation had increased mechanical strength than semi rigid osteosynthesis. The rigid non compressive osteosynthesis had gap healing with formation of small amount of callus.

Raveh et al reported that out of 531 mandibular fractures treated by AO plate and immediate mobilisation only two caseshad malocclusion. They performed all cases by introral approach and had a special localisation device to be placed across the fracture line to facilitate plating. Kai Tu and Tenbulzen (1985) and Pogrel (1986) reported that in their series upto 25% of cases needed some adjustment by occlusal grinding to correct malocclusion.

In 1999, Fordyce et al did a retrospective study and compared 66 patients of mandibular fracture without intraop MMF with 49 patients with intraop MMF. They found there was no significant occlusal discrepancy in the two groups.

In 2002, Dimitroulis did a retrospective clinical study in patients with fracture of angle of mandible. He compared 11 patients who had intraop IMF and 20 patients who had manual reduction of mandible. He found that when IMF was not applied the operative time and hospital stay were less. He also found that post operative outcomes were similar in both groups.

In 2007, Vural E published his results of 16 patients who underwent manually provided intraoperative temporary maxillomandibular fixation for open reduction and internal fixation. Of the 16 patients, only one patient had malocclusion.

In 2007, David Wilson studied mandibular angle fractures managed by open reduction and internal fixation. He divided the study group in to three groups basedon the intra operative MMF utilised- group 1- erich arch bar, group 2- 24 gauge iterdental wires and group 3- manual reduction. He found no significant difference in the outcome and complication in the three groups.

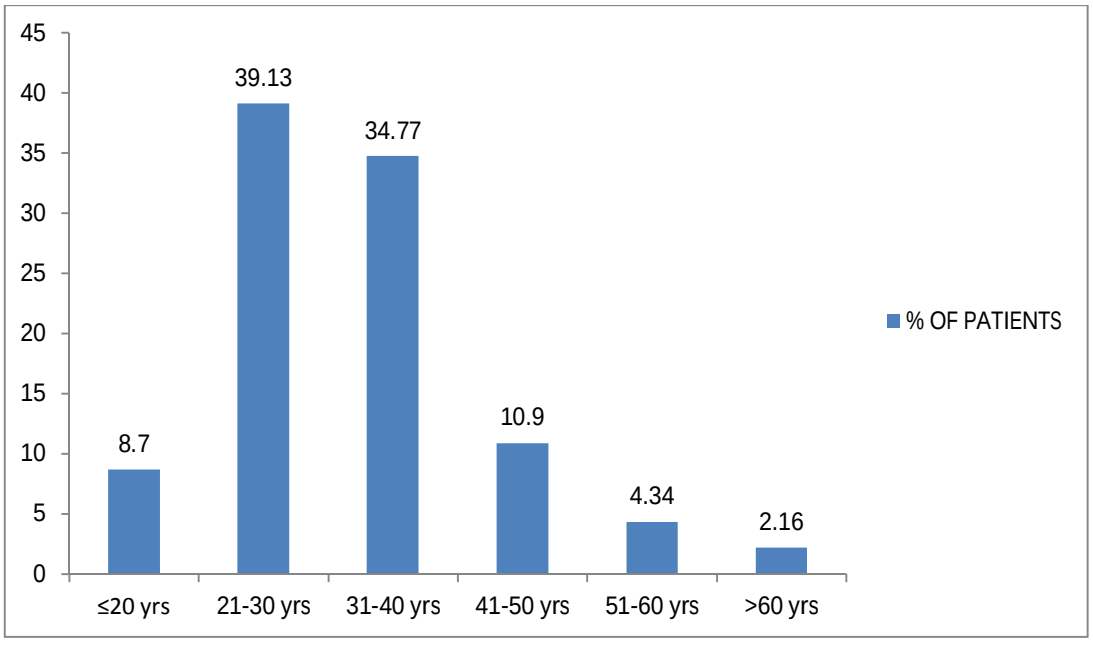
In 2009, Mathieu Laurentjoye reviewed 184 patients who had manual reduction and semi rigid mini plate osteosynthesis for fracture mandible. The functional result was similar to that reported in literature.

OBSERVATION AND ANALYSIS

The total number of patients who underwent rigid fixation of mandible with intra operative manual reduction and without MMF were forty six.

TABLE-1: AGE WISE DISTRIBUTION OF MANDIBLE FRACTURES

AGE GROUP	NUMBER OF PATIENTS	PERCENTAGE
≤ 2O YEARS	4	8.70
21- 30 YEARS	18	39.13
31- 40 YEARS	16	34.77
41- 50 YEARS	5	10.90
51- 60 YEARS	2	4.34
> 60 YEARS	1	2.16



In the study group, the youngest patient was 18 year old male and the oldest patient was 62 years old male. About 73.9% (34 patients) of the study population were in the age group of 21- 40 years. Majority of the injured patients were of the age group of 21- 30 years.

GENDER DISTRIBUTION –

Of the total forty six patients, forty three were male and three were female. About 93.48% of the study population were male.

GENDER WISE DISTRIBUTION

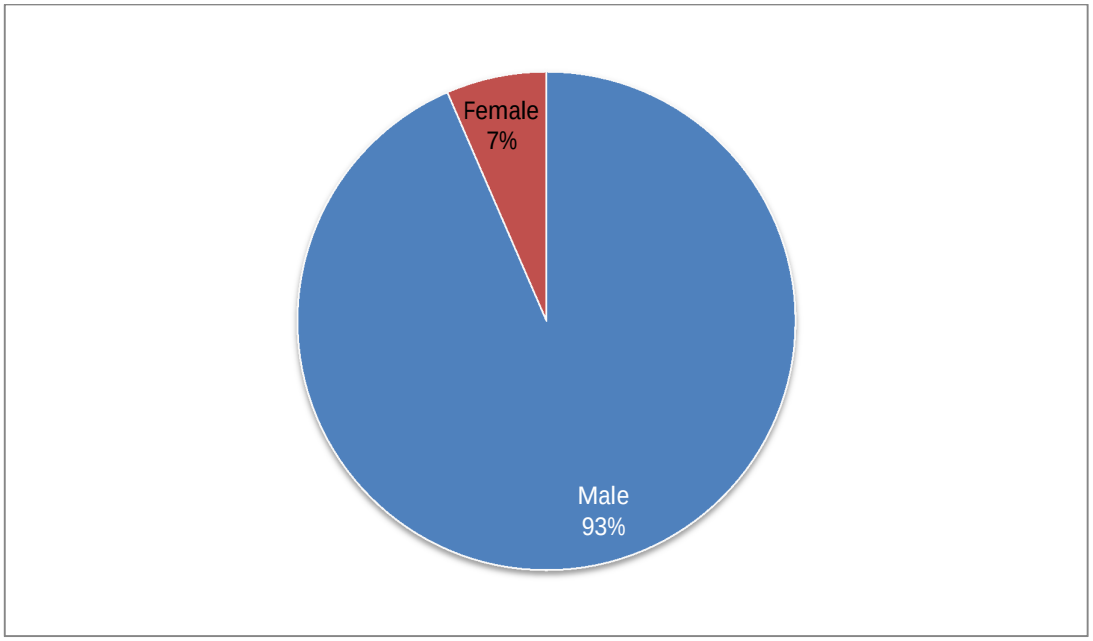


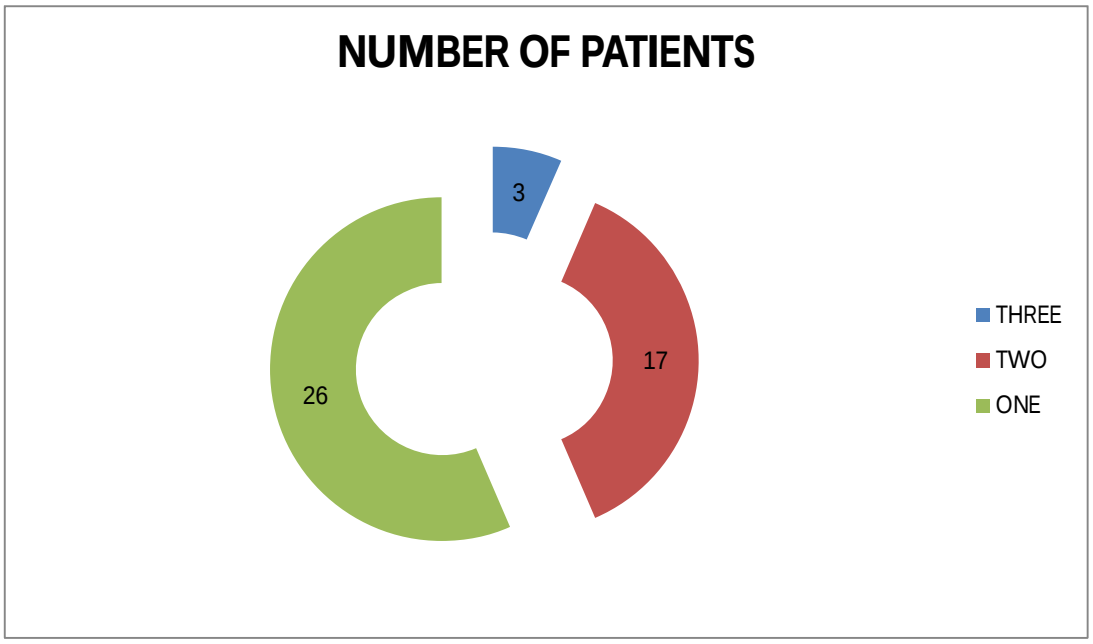
TABLE -2: CAUSES FOR MANDIBLE FRACTURE

CAUSE	NUMBER OF PATIENTS	PERCENTAGE
Road traffic accident	29	63.04
Assault	13	28.26
Accidental fall	4	8.70

Of the forty six patients, twenty nine were injured due to road traffic accident , thirteen were injured due to assault and four were injured due to accidental fall. The most common cause was road traffic accident constituting 63.04%.

TABLE - 3: NUMBER OF FRACTURES

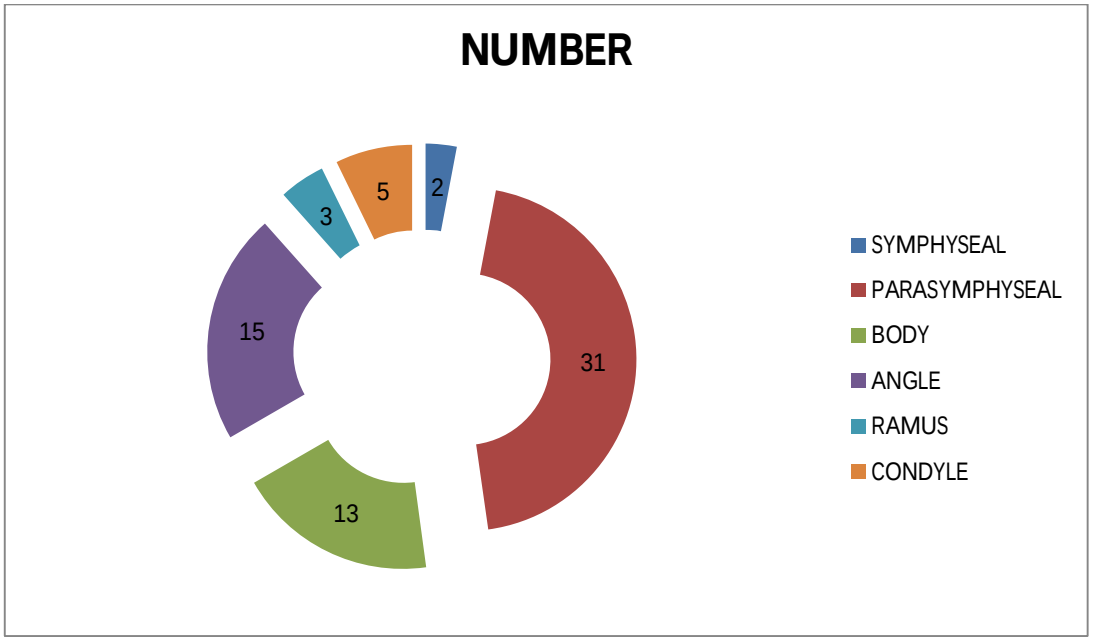
NUMBER OF FRACTURES	NUMBER OF PATIENTS	PERCENT
Three	3	6.52
Two	17	36.96
One	26	56.52



A total of 69 fractures were studied. About 56.52% had single fracture of mandible.

TABLE -4: SITES OF FRACTURES

SITE	NUMBER	PERCENT
SYMPHYSEAL	2	2.90
PARASYMPHYSEAL	31	44.93
BODY	13	18.84
ANGLE	15	21.74
RAMUS	3	4.35
CONDYLE	5	7.24



In our study, there was no patient with fracture of dento alveolar process and coronoid process. Parasymphyseal region was the most commonly fractured site

constituting about 44.93%. All the five condylar fractures were involving the neck of the condyle.

DOUBLE FRACTURE-

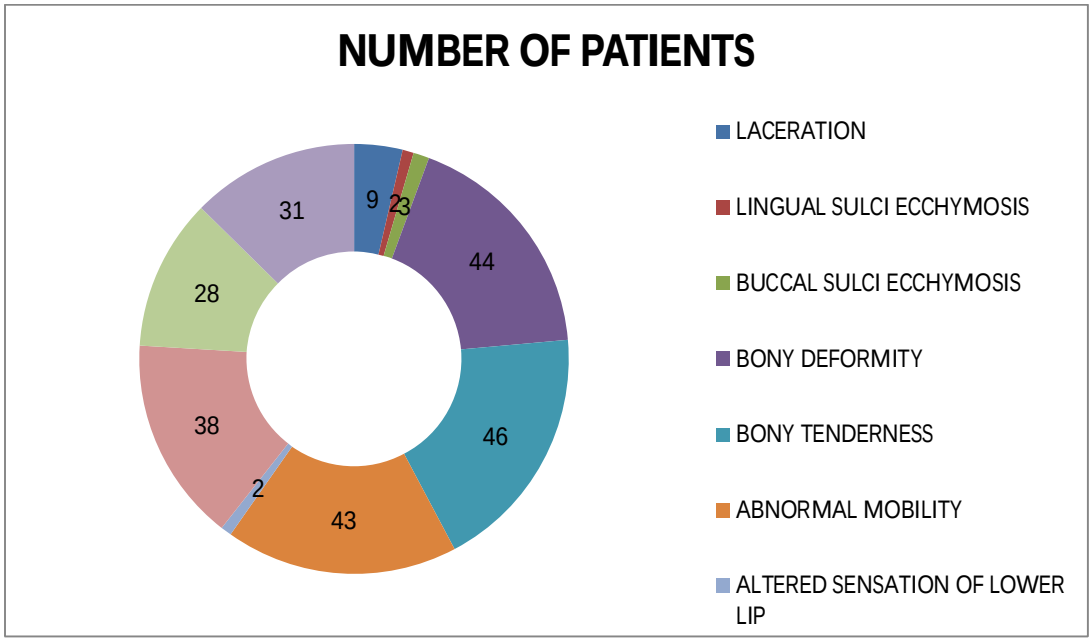
Of the seventeen patients having double fractures, fifteen were bilateral and two were unilateral. In patients having bilateral fractures, the combination of parasymphyseal in one side and angle in the other side was most common and seen in eight patients.

TRIPLE FRACTURES-

Of the study population, 6.52% had fracture at three sites. In all these patients both sides of mandible were involved.

TABLE-5: CLINICAL FEATURES

S.NO	FEATURE	NUMBER OF PATIENTS	PERCENTAGE
1	Laceration	9	19.57
2	Lingual sulci ecchymosis	2	4.35
3	Buccal sulci ecchymosis	3	6.52
4	Bony deformity	44	95.65
5	Bony tenderness	46	100
6	Abnormal mobility	43	93.48
7	Altered sensation of lower lip	2	4.35
8	Mal occlusion	38	82.61
9	Loss of teeth	28	60.87
10	Loose teeth	31	67.39



Of the forty six patients thirty seven had simple fracture and nine had compound fracture. All the patient had bony tenderness at the fracture site. The nine patients who had skin and mucosal lacerations underwent suturing under local anaesthesia and were then evaluated for fracture.

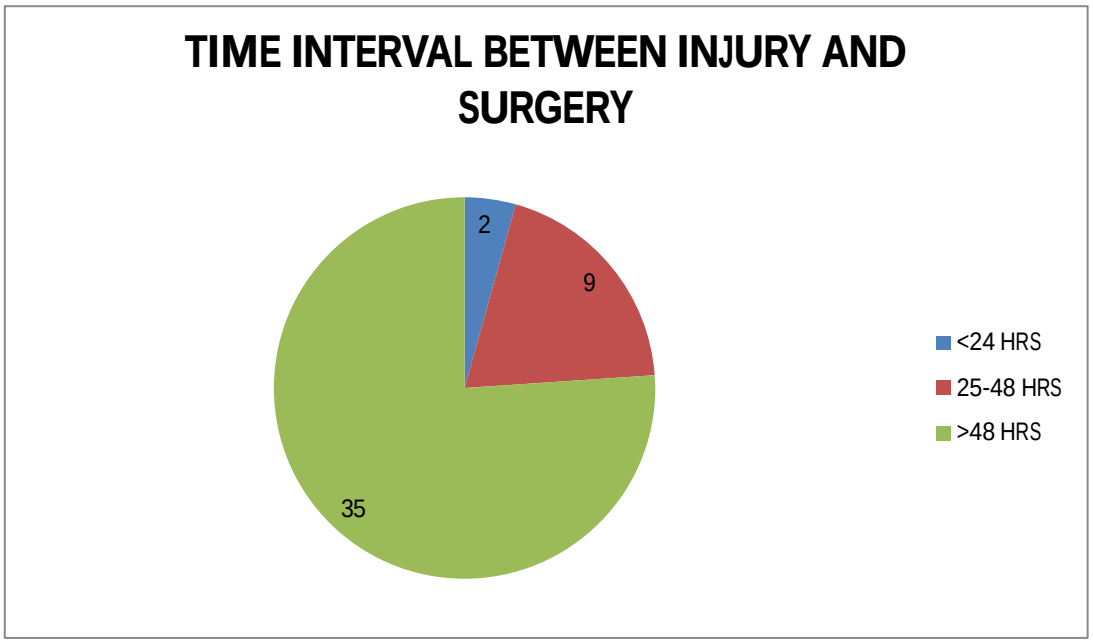
TABLE- 6:ANALYSIS OF INVESTIGATIONS DONE FOR EVALUATION OF MANDIBLE FRACTURES

S NO	INVESTIGATION	NUMBER OF PATIENTS	PERCENT
1	DIGITAL X RAY	36	78.26
2	OPG	46	100
3	CT – 3D RECCONSTRUCTION	31	67.39

All the 46 patients underwent OPG before surgery. Only 67.39% had CT facial bones with 3D reconstruction.

TABLE-7: TIME INTERVAL BETWEEN INJURY AND SURGERY

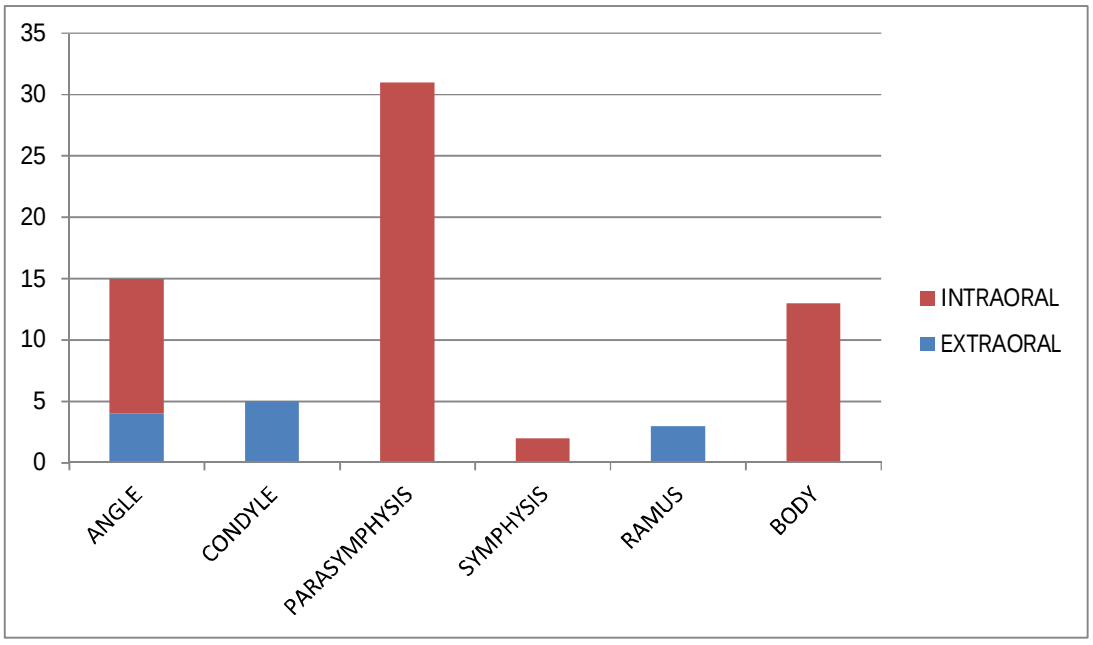
S NO	TIME AFTER INJURY	NUMBER OF PATIENTS	PERCENT
1	≤24 HOURS	2	4.34
2	25-48 HOURS	9	19.57
3	>48 HOURS	35	76.09



Majority of the patients had surgery after 48 hours.

TABLE-8: INCISION FOR SURGERY

S.NO	FRACTURE SITE	INCISIONS	
		EXTRA ORAL	INTRA ORAL
1	ANGLE	4	11
2	CONDYLE	5	0
3	PARASYMPHYSIS	0	31
4	SYMPHYSIS	0	2
5	RAMUS	3	0
6	BODY	0	13
	TOTAL	12	57



The fracture site were exposed by extra oral incisions in twelve patients and intra oral incision in 57 patients.

Patients with high angle, ramus and condyle fractures had extra oral incisions. Symphyseal, Para symphyseal, body and some angle fractures were managed by intra oral incisions.

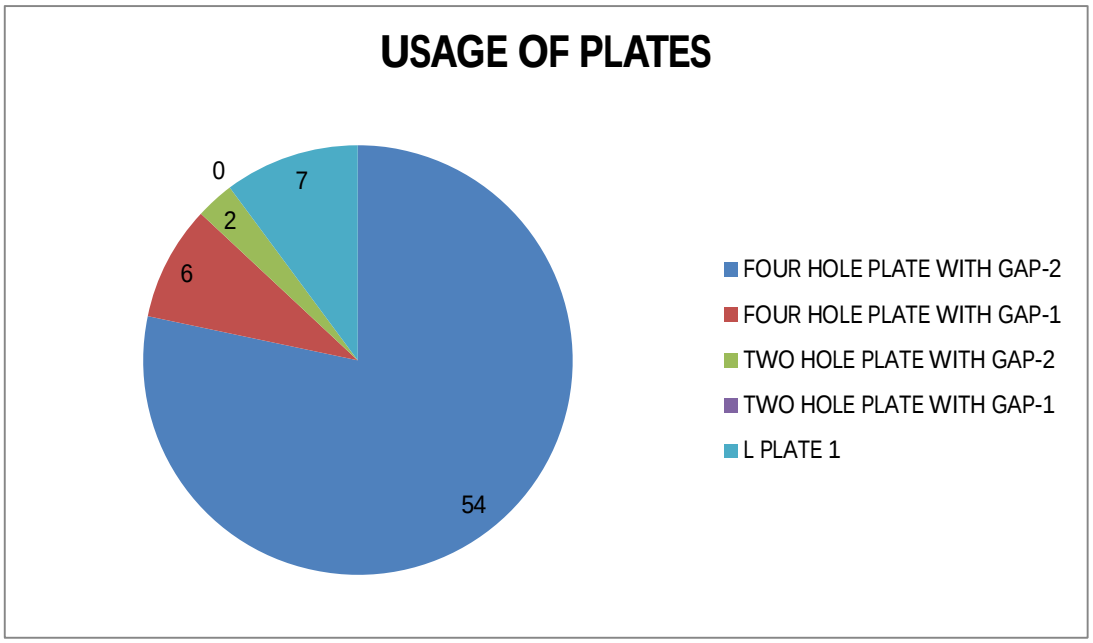
TABLE-9:DURATION OF SURGERY

S NO	TIME	NUMBER OF PATIENTS	PERCENTAGE
1	<1 HOUR	4	8.69
2	1-2 HOURS	27	58.69
3	2-3 HOURS	11	23.93
4	>3 HOURS	4	8.69

Duration for the surgery was calculated from the time of incision to the time of wound closure. About 63.19% of the patients had surgery done within two hours. The minimum time for surgery was 45 minutes and maximum was 205 minutes.

TABLE-10: USAGE OF PLATES

S.NO	TYPE AND NUMBER OF PLATES	NUMBER OF PATIENTS
1	FOUR HOLE PLATE WITH GAP- 2	54
2	FOUR HOLE PLATE WITHGAP-1	6
3	TWO HOLE PLATE WITH GAP-2	2
4	TWO HOLE PLATE WITH GAP-1	0
5	L PLATE-1	7



L plates were used predominantly for angle fractures. Two hole plates were used as an additional plate for angle fractures. Fractures fixed by single four hole plate were predominantly condylar neck fractures.

TABLE-11: TIME TAKEN TO START ON CLEAR FLUIDS

S.NO	TIME AFTER SURGERY	NUMBER OF PATIENTS	PERCENTAGE
1	6-12 HOURS	31	67.39
2	12-24 HOURS	13	28.26
3	>24 HOURS	2	4.35

Patients were advised to have clear fluids as tolerable about 6 hours after surgery. All the patients received parenteral anti emetic. Most of the patients had clear fluids within first twelve hours of surgery.

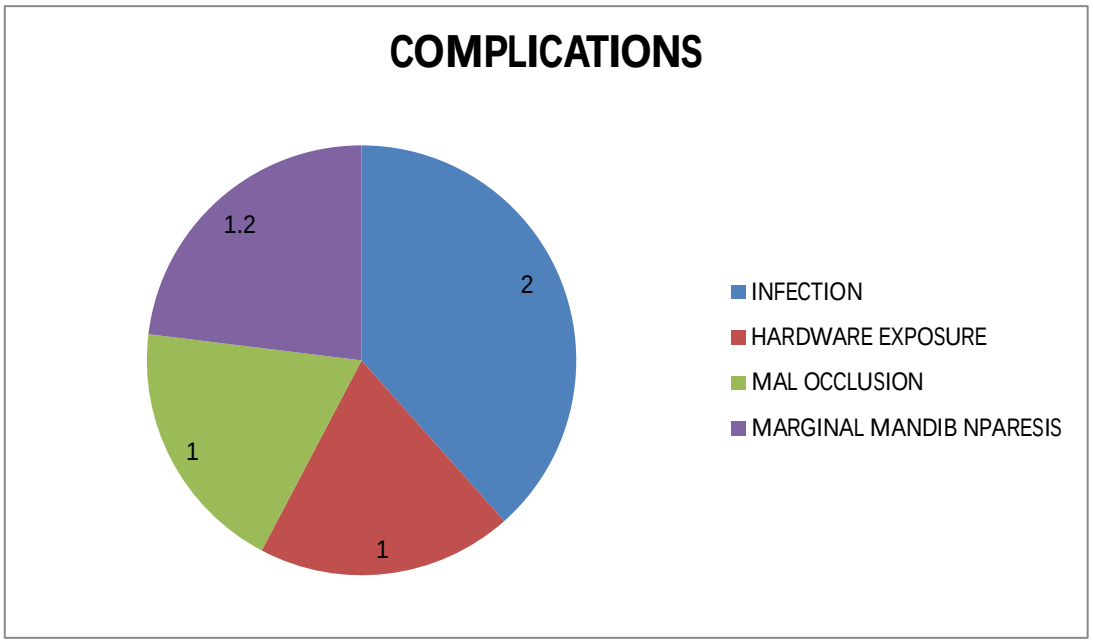
TABLE-12: TIME TAKEN TO START ON SOFT DIET

S.NO	HRS AFTER SURGERY	NUMBER OF PATIENTS	PERCENTAGE
1	24-48 HOURS	34	73.91
2	49-72 HOURS	7	15.22
3	>73 HOURS	5	10.87

Most of the patients had soft diet by first post operative day.

TABLE-13: COMPLICATIONS

S.NO	COMPLICATION	NUMBER OF PATIENTS	PERCENTAGE
1	INFECTION	2	4.35
2	HARDWARE EXPOSURE	1	2.17
3	MAL OCCLUSION	1	2.17
4	MARGINAL MANDIB N PARESIS	1	2.17



Of the forty six patients, six patients had complications.

Of the two patients with infection, one healed with antibiotics and one needed drainage under anaesthesia. Both the patients had compound fracture.

One patient who had fixation of single parasymphyseal fracture with two four hole mini plates with gap had to undergo implant removal under anaesthesia six months after the surgery.

The patient who had mal occlusion had fixation for triple fracture. He was advised to undergo refixation, which he refused. On his review at six months after surgery, he told he had satisfactory occlusion and that he was able to have solid diet, hence he was not willing for any procedure.

One patient who had paresis of marginal mandibular nerve recovered by three months.

DISCUSSION

AGE GROUP AND GENDER DISTRBUTION-

In our study, the most common age group affected was 21-30 years and males (93.48%) were commonly affected than females (6.52%). This is comparable to other studies.

Wang et al in their study had a mean age of 23 years. The study had 27 males and two females in their study population of 29.

Wimon Sirimaharaj and Kasemsak Pyungtanasup reported 21-30 years as the most common age group affected in his study conducted at Chiang Mai University, Thailand. They also reported that 83% males and 17% females sustained mandibular fractures.

In a study of mandibular fracture done at Pakistan Institute of Medical Sciences, Islamabad, by Ajmal et al, mean age was 26 years and 85% of the study population were males.

CAUSES FOR MANDIBULAR FRACTURES-

Road traffic accidents caused 63.04% of mandibular fractures followed by assault constituting 28.26% and then by accidental fall 8.70%. These results are similar to those studies done earlier.

In a retrospective study of 2137 patients with mandibular fractures done by Ellis et al 43% were due to vehicle accidents, 34% by assaults, 7% were work related, 7% were due to fall, 4% were sport injuries and 5% were miscellaneous causes. In the study done by Wang et al assault were the most common cause of mandible fractures followed by motor vehicle accidents. Sirimaharaj et al reported motorcycle accidents to be the most common cause followed by assaults and then by falls. Ajmal et al reported 80% of cases due to road traffic accidents.

NUMBER AND SITES OF FRACTURES-

There were 56.52% of solitary mandibular fractures and 43.48% of multiple mandibular fractures, with an average of 1.5 fractures per person. This is similar to that reported in literature.

Sirimaharaj et al reported 40.4% of multiple mandibular fractures and average of 1.44 fractures per person. Ajmal et al reported 54% of solitary mandibular fractures and 46% of multiple mandibular fractures. In their study there was an average of 1.5 fractures per person.

In the present study, parasymphyseal fractures were most common constituting 44.93% followed by 21.74% in angle. Among bilateral fractures the most common combination is parasymphyseal in one side and angle in other side. Wang et al had more fractures in angle followed by parasymphyseal and then

body. Sirimaharaj et al reported 45.30% of parasymphysis fracture, 19.51% of angle fracture, 15.68% of condyle fractures , 13.24% of symphysis fracture and 3.83% of ramus fractures. Ajmal et al reported parasymphyseal fractures to be most common followed by body, angle, condyle and ramus.

CLINICAL FEATURES-

All the patients had bony tenderness in the fracture site. Bony deformity was seen in 95.65% and abnormal mobility seen in 93.48%. Malocclusion was present in 82.61%.

Mathieu Laurentjoye reported malocclusion in 77% of patients with unifocal mandible fractures and 85.50% in bifocal fractures.

DURATION OF SURGERY-

In the present study 8.69% got operated within 60 mins and 58.69% got operated within 120 mins.

Dimitroulis noted the mean operating time for ORIF of angle fractures was 98.5 mins when MMF applied and 40.2 minutes when MMF not applied.

Fordyce et al has stated that it takes at least 40 minutes to apply arch bar or eyelet wire or MMF intraoperatively.

COMPLICATIONS-

In the present study the complication rate was 13.04%. the infection rate is 4.35% and malocclusion is 2.17%. This is similar to that seen in other studies.

In various studies, complication rate ranges from 7 to 29%. Fordyce et al had 4% infection rate and 19% of early malocclusion rate.

Mathieu Laurentjoye observed 0.67% of disturbed occlusion. Ajmal et al had complication rate of 3.2% with most common complication being infection.

SUMMARY AND CONCLUSIONS

A total of forty six patients with sixty nine fractures of mandible had ORIF with intra operative manual maintenance of occlusion. These patients did not have any intra operative or post operative MMF or arch bar application to maintain occlusion.

The conclusions made from the study are given below -

- Male (93.48%) were more commonly affected.
- The most commonly affected age group was 21-30 years (39.13%).
- Road traffic accidents were the most common cause (63.04%).
- Majority of the patients (56.52%) had single fracture of mandible.
- Parasymphyseal fractures (44.93%) were the most common fractures.
- On average there was 1.5 fractue per person.
- Bony tenderness (100%), bony deformtity (95.65%), abnormal mobility (93.48%) and malocclusion (82.61%) were the commonly seen clinical findings.
- OPG was the mainstay of investigation and all the forty six patients had OPG.
- Most (82.61%) of the patient had surgery through intraoral incision.
- About 63.19% of patients got operated within two hours.

- About 67.39% had fluid diet within first twelve hours after surgery and 73.91% had soft diet within first 48 hours.
- The post operative infection rate was 4.35%.
- Of the forty six patients only one patient (2.17%) had malocclusion.

Rigid fracture fixation of mandible can be done without intra operative or post operative maxillo mandibulary fixation or arch bar application. Good reduction and occlusion can be obtained with manual reduction. This technique reduces the operative time and aids in early mobilisation and better intake of diet.

Mandible fractures can be managed by Open reduction and internal fixation with intra operative manual maintenance of occlusion and satisfactory results can be obtained.

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PROFORMA

1. NAME-
2. AGE/SEX-
3. PS NO-
4. ADDRESS-
5. MOBILE NO-
6. OCCUPATION-
7. SOCIOECONOMIC STATUS-
8. DATE OF INJURY-
9. NATURE OF INJURY-
10. DATE OF SURGERY-
11. OTHER INJURIES-
12. OTHER CO MORBIDITIES-
13. PREOP OPG, XRAYS-

14. SITE AND NO OF FRACTURES-

15. METHOD OF FIXATION

16. TIME AT WHICH MOBILISATION STARTED-

17. TIME AT WHICH ORAL FLUIDS STARTED-

18. IMMEDIATE POST OPERATIVE PERIOD-

19. POST OP OPG-

20. FIRST WEEK AFTER SURGERY-

21. END OF FIRST MONTH-

22. END OF THIRD MONTH-

23. ASSESSMENT-

INTEGRITY OF BONY UNION

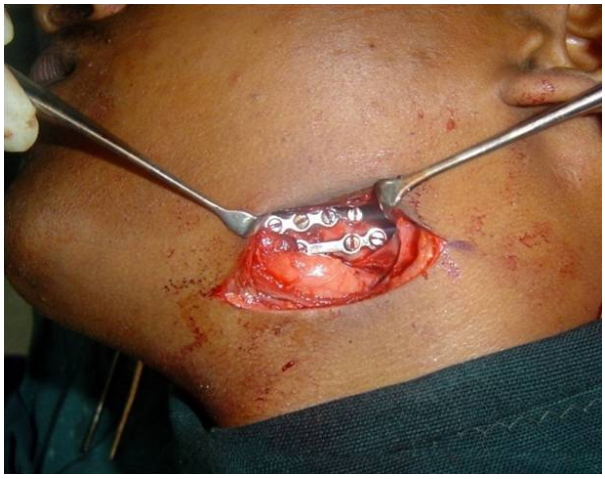
OCCLUSION STATUS

ANY POST OP INFECTION

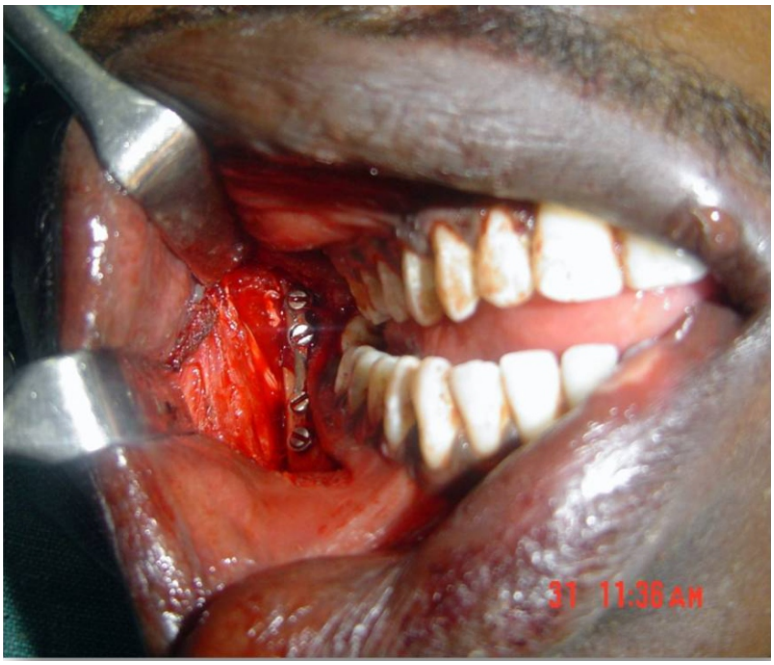
INTRA OPERATIVE OCCLUSION MAINTENANCE

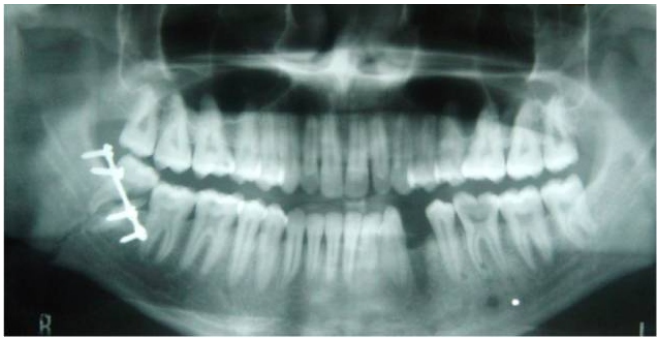
FIXATION OF RIGHT PARASYMPHYSEAL AND LEFT BODY FRACTURE

FIXATION OF LEFT ANGLE FRACTURE BY RISDON INCISION

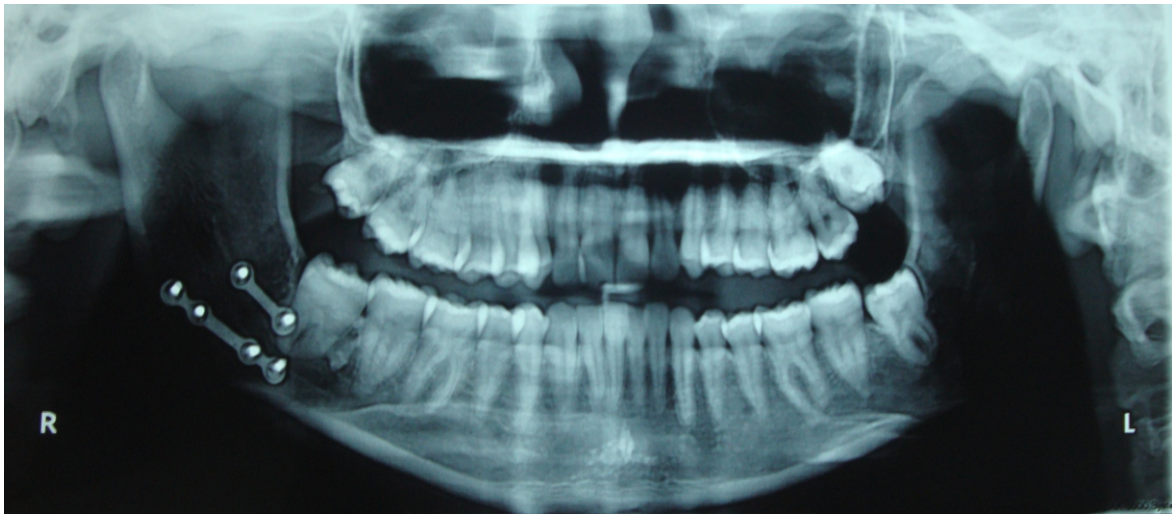


FIXATION OF RIGHT ANGLE FRACTURE BY INTRA ORAL INCISION





RIGHT ANGLE FRACTURE



COMPOUND FRACTURE OF MANDIBLE